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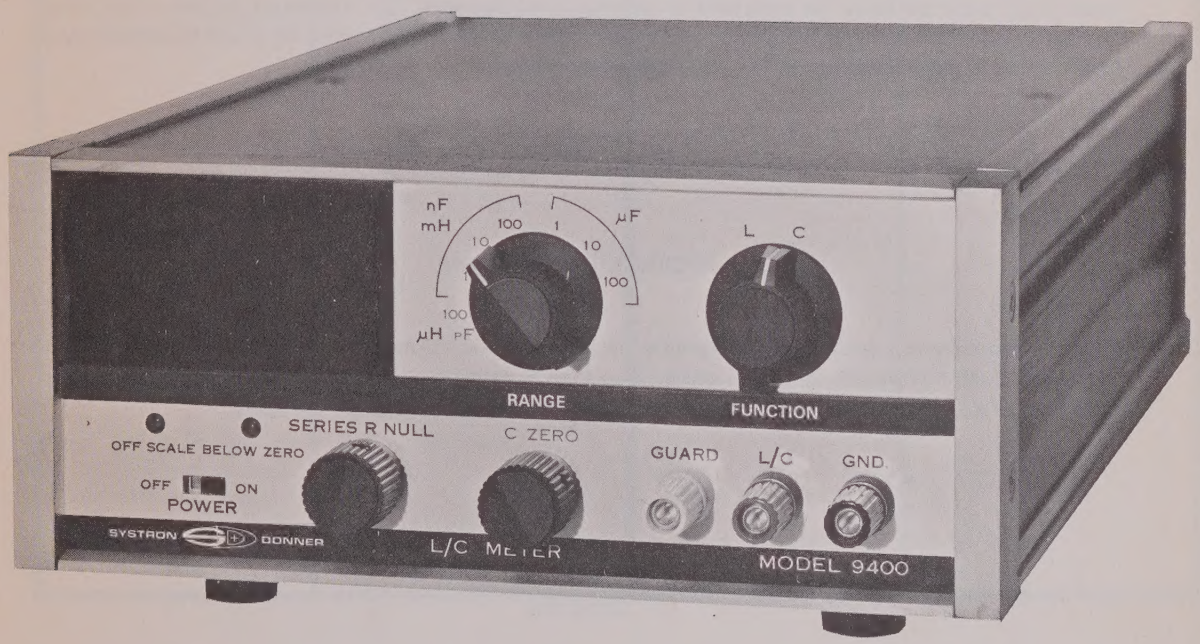
CONCORD INSTRUMENT
DIVISION

MODEL 9400
DIGITAL L/C METER

SYSTRON DONNER

Concord Instrument Division

INSTRUCTION MANUAL



CONCORD INSTRUMENT
DIVISION

MODEL 9400
DIGITAL L/C METER

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SYSTRON DONNER
CORPORATION

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LIST OF EFFECTIVE PAGES

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

The Model 9400 is a portable Digital L/C Meter. This instrument provides a fast and easy method for measuring inductors and capacitors. Extensive use of integrated circuits and other proven solid state components give this unit excellent reliability while the single board construction allows for easy maintenance.

The Standard Model 9400 provides the following features:

1) An easily read storage type display permits the initial reading to be observed while a new measurement is being made.
2) Decimal point is automatically positioned.
3) Capacitance measurements range from 100pF to 100μF.
4) Inductance measurements range from 100μH to 100mH.
5) BCD output is built-in.
6) Unit may be operated on either 115V or 230V ac line.

1.2 FUNCTIONAL DESCRIPTION

The Model 9400 L/C Meter will measure inductors and capacitors with up to .1μH or .1pF resolution. The two modes of operation are L (inductance) and C (capacitance).

1.3 SPECIFICATIONS

The following Table 1.1 lists the specifications applicable to the Model 9400:

TABLE 1.1 SPECIFICATIONS

Capacitance	Full Scale Ranges	100pF to 100μF, in 7 decade steps.
	Accuracy	±1% full scale ±1 digit, ±1% of reading to 100% full scale ±1 digit.
	Resolution	0.1pF on the 100pF scale.
	Lead Capacitance	Adjustable for zero indication in 100pF, 1nF, and 10 nF ranges. (Red lettered ranges and C ZERO knob)

TABLE 1.1 SPECIFICATIONS (Con't.)

Inductance	Full Scale Ranges	100µH to 100mH in four decade steps.
	Accuracy	±1% full scale ±1 digit ±1% or reading to 100% full scale ±1 digit.
	Resolution	0.1µH on the 100µH scale.
	Coil Resistance	Can be nulled with SERIES R NULL.
General	Power	115/230V ac and 50-400 Hz.
	Dimensions	3-1/2" high by 8-1/4" wide by 13" deep.
	Weight	7.5 lbs. net weight, 12.0 lbs. shipping weight.
	BCD Output	Printer output consists of a 1-2-4-8 digital output with the following characteristics: *"1" = +5V nominal. *"0" = 0V nominal. *Source Impedance = 5 kΩ. *Print Command = 0-5V dc for 20 msec. *Inhibit Command = 0V inhibits and open circuit or +5V operates.

CHAPTER 2
INSTALLATION

2.1 INTRODUCTION

Procedures for inspection and initial installation of the Model 9400 are presented below. Reshipment instructions have been included should the instrument require return to Systron-Donner Corporation.

2.2 RECEIVING INSPECTION

Before accepting the instrument from the shipper, inspect the instrument's shipping container for signs of external damage. Any sign of such damage must be noted by both the shipper and customer and should be reported to the insurance investigator.

As soon as the instrument is unpacked inspect it for shipping damage. Check for scratches or dents, broken or cracked knobs, and damaged connectors. Should any damage be found, notify your nearest Systron-Donner representative -- do not use the instrument until instructed to do so by the representative.

2.3 INSTALLATION

Initial installation of the Model 9400 includes power connection and cooling. The Model 9400 may be operated from a 115 or a 230 volt ac (±10%) power source.

The instrument may be converted for 230 volt ac operation by removing the bottom cover; then, removing the jumpers between pins 1 and 2, 3 and 4 of the transformer. Connect jumper between 2 and 3 and change fuse; then, replace bottom cover. The instrument is factory supplied with a 115 volt, 1/2 A fuse. Be sure to replace this fuse with a 1/4 A fuse for 230 volt operation. (See Figure 2.1).

CAUTION

Before connection of instrument into ac power line, make sure LINE jumpers are properly installed for available line voltage.

The Model 9400 is equipped with a standard three conductor power cord that automatically grounds the unit when a matching power outlet is available. An adapter which provides an instrument ground should be used whenever the power cord must be connected to a two-contact outlet.

2.3.1 COOLING

Model 9400 L/C Meter uses convection and radiation for cooling. Therefore the instrument should not be placed in an area of high ambient temperature or dead air space where air connot move around it.

2.4 RESHIPMENT

Should it become necessary to re-ship the instrument, contact the nearest Systron-Donner field office for shipping instructions. If possible use the original packaging materials or replace the packing in accordance with MIL-P-116 and MIL-E-17555E. The field office can provide materials similar to those used for original factory packaging. All correspondence should refer to the full nomenclature and serial number of the instrument.

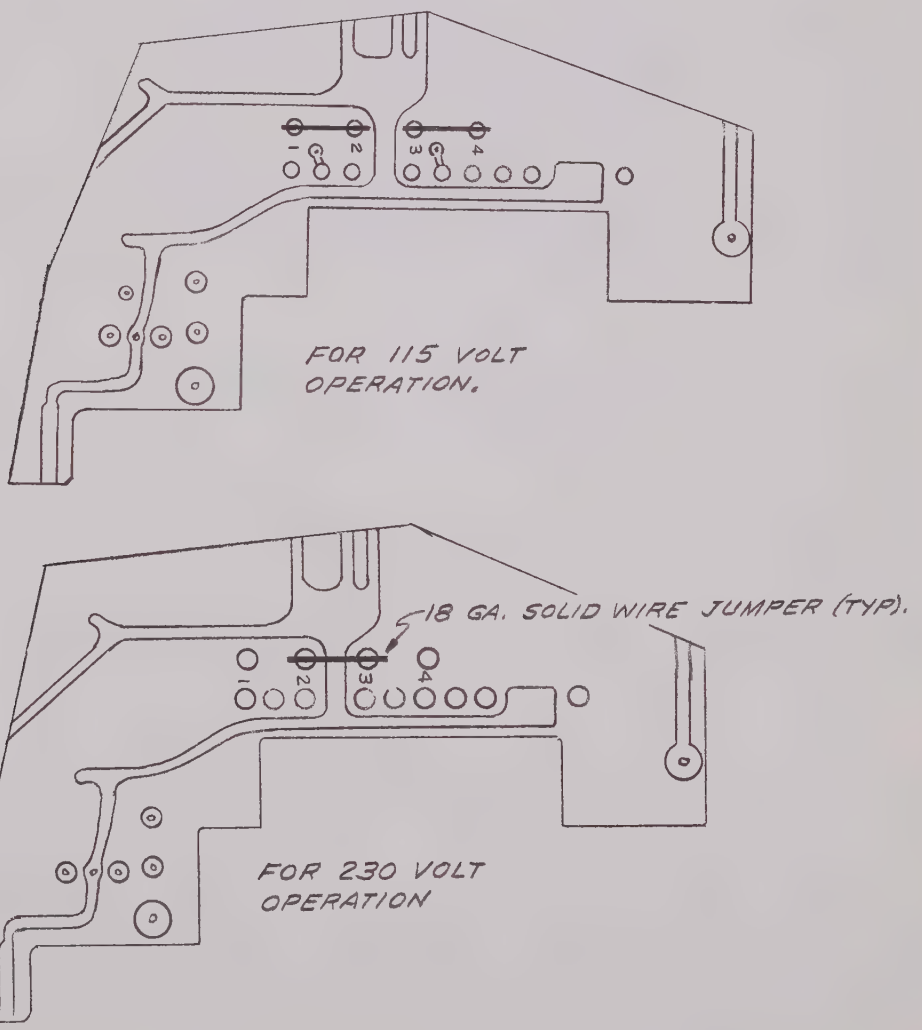


FIGURE 2.1 POWER JUMPER CHANGE FOR 115V and 230V

CHAPTER 3
OPERATION

3.1 INTRODUCTION

This section describes the Model 9400 controls, connectors, and indicators. Initial turn-on and operational checks are included along with step-by-step operating procedures listing each of the L/C meter's basic functions. Also included is information about various factors which effect the accuracy of the L/C Meter.

3.2 CONTROLS, CONNECTORS, AND INDICATORS

Figures 3.1 and 3.2 illustrate the Model 9400 front and rear panel controls, connectors and indicators. Tables 3.1 and 3.2 provide a description of their functions.

TABLE 3.1 FRONT PANEL

FIGURE	INDEX	NAME	FUNCTIONS
3.1	1	Power ON/OFF (switch)	Turns ac power to instrument on or off.
3.1	2	BELOW ZERO (indicator)	This indicator lights when the indication is below zero on the 100pF, 1nF and 10nF ranges. (Note: disregard on all other ranges.)
3.1	3	SERIES R NULL (control)	This control is used to null the resistance of the unknown inductor being measured.
3.1	4	C ZERO (control)	This control is used to zero the instrument with the leads open on the 100pF, 1nF or 10nF ranges.
3.1	5	GUARD (connector)	This terminal provides a guard voltage output which in phase and equal in amplitude with the measurement signal for making guarded capacity measurements.
3.1	6	L/C (connector)	Connect one lead of unknown inductor or capacitor to this terminal for measurement.

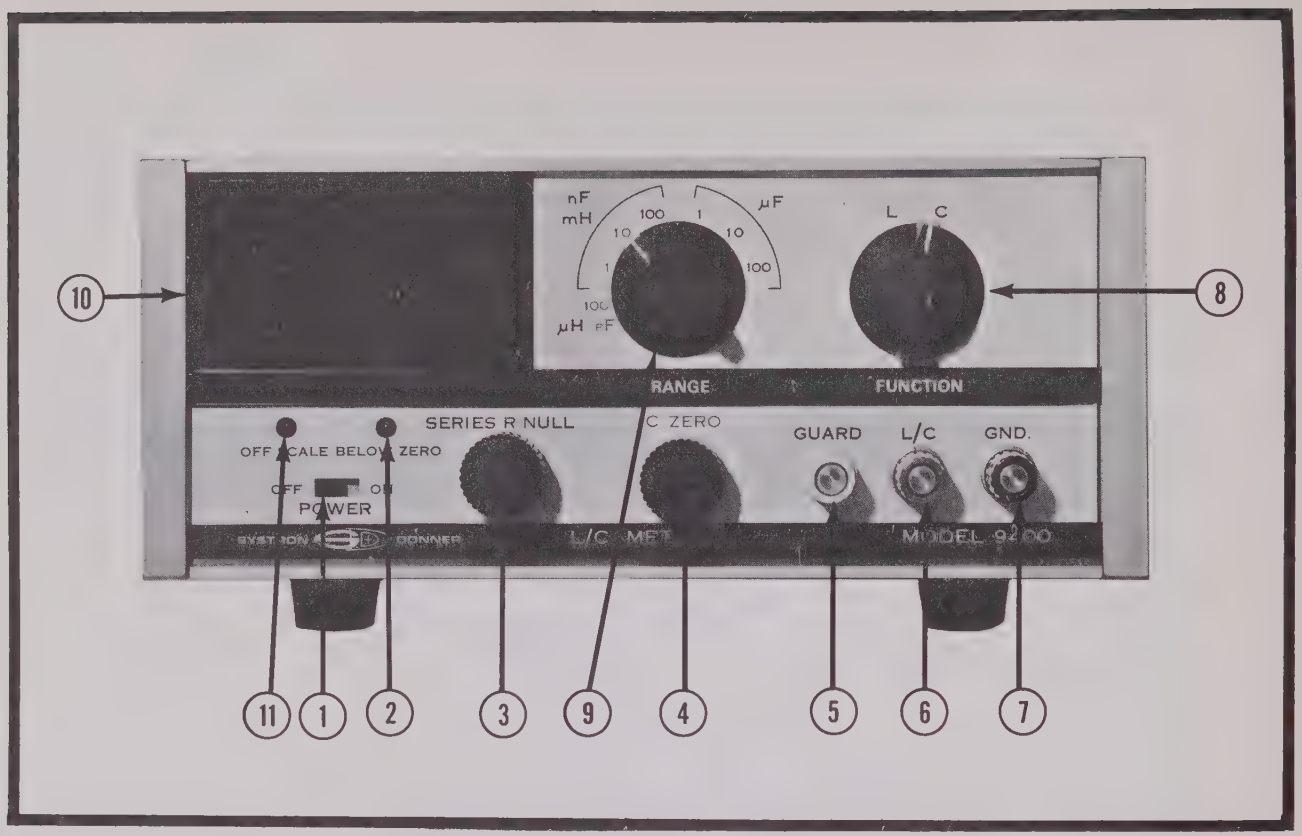


FIGURE 3.1 FRONT PANEL, MODEL 9400

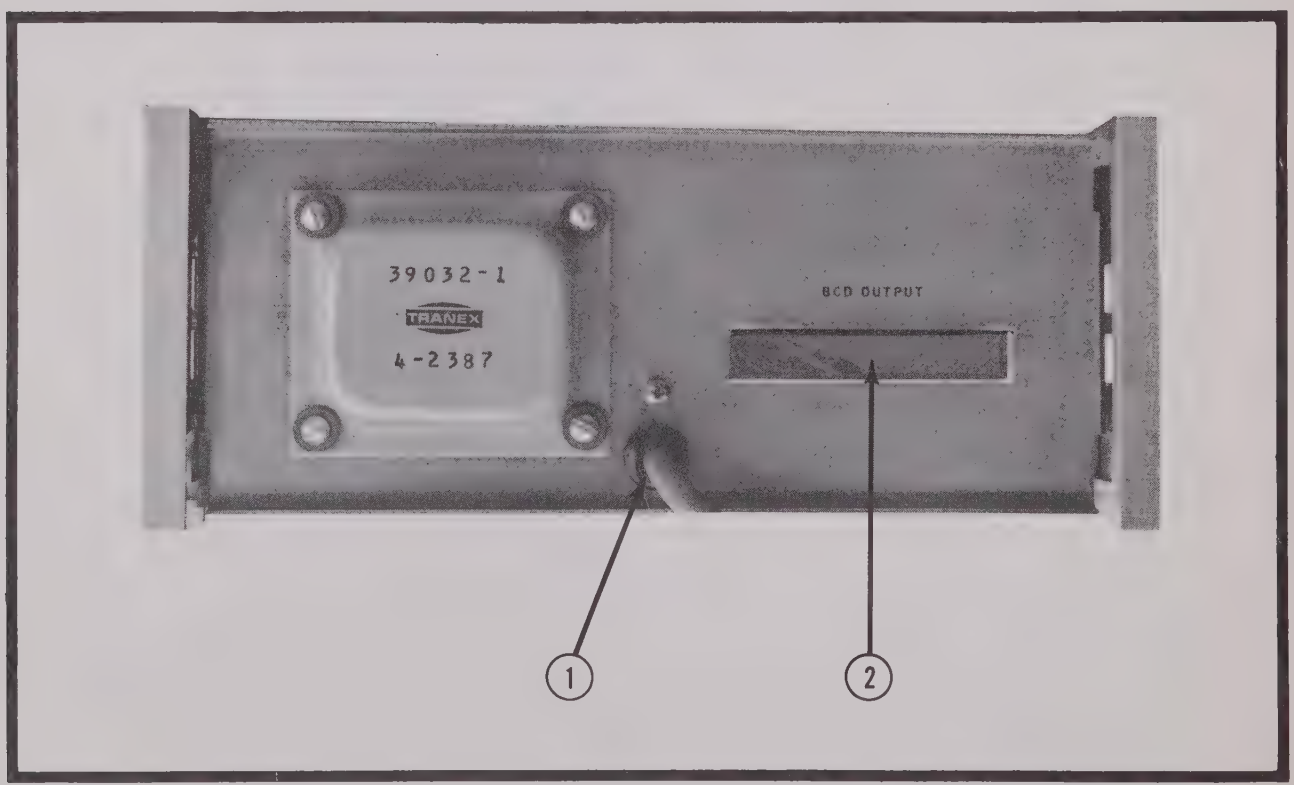


FIGURE 3.2 REAR PANEL, MODEL 9400

TABLE 3.1 FRONT PANEL (Con't.)

FIGURE	INDEX	NAME	FUNCTIONS
3.1	7	GND (connector)	Connect other lead of unknown inductor or capacitor to this terminal.
3.1	8	FUNCTION (switch)	Selects L for Inductance measurement or C for Capacitance measurement.
3.1	9	RANGE (switch)	This switch selects the proper range for measurement.
3.1	10	DISPLAY	Provides visual display of measurement from 000 to 1999.
3.1	11	OFF SCALE (indicator)	Provides off scale indication for readings above 1999.

TABLE 3.2 REAR PANEL

FIGURE	INDEX	NAME	FUNCTIONS
3.2	1	LINE CORD (connector)	Allows connection to 115V ac ±10% or 230V ac ±10%.
3.2	2	BCD (connector)	Provides BCD information for digital records, etc.

3.3 INITIAL TURN-ON AND OPERATIONAL CHECK

The following procedure checks the Model 9400 for any major internal shipping damage. Successful completion of this series of tests should precede any performance tests.

1) Connect ac line cord to 115V ac source (Note: if 115V ac source is not available remove bottom cover and remove jumpers between (1 & 3) and (2 & 4) on transformer. Add jumper between 2 & 3. Change F1 from 1/2A to 1/4A. The unit is now wired for 230V ac operation.)
2) Set POWER switch to on (display should illuminate).
3) Set FUNCTION switch to C.
4) Set RANGE switch to 100pF.
5) Rotate C ZERO control and observe the display change from some nominal (approx. 8pF) to 000 and BELOW ZERO indicator lights.

6) Set C ZERO control so display indicates 000 + 1, or BELOW ZERO indicates.

7) Connect a 100pF capacitor to measurement terminals and observe display. The reading should be ~1050 as the Model 9400 will read approximately 5% high at turn-on.

8) Allow unit to warm up for 1 hour before making any performance tests.

3.4 OPERATING PROCEDURES

The following subsections explain the operating procedures for measuring an unknown inductance or capacitance.

3.4.1 GENERAL

1) It is recommended that power be left on the Model 9400 at all times as it requires 1 hour warm up time for specified accuracy.

2) The use of test leads is not recommended on the 100pF or 1nF ranges due to the limited range of the C ZERO control. On the 100μH range the test lead inductance may become an appreciable part of the total inductance.

3) Do not operate the Model 9400 on its side. Set it on its feet or tilt stand.

4) Disregard BELOW ZERO indicator on ranges printed in black.

3.4.2 CAPACITANCE MEASUREMENTS

1) Set FUNCTION switch to C.

2) Set RANGE switch to 100μF.

3) Connect unknown capacitor between L/C and GND terminals.

4) If making a measurement on a guarded input, connect GUARD output of Model 9400 to guard of device being measured.

5) Decrease the RANGE switch setting until the readout value is over 20% of the RANGE selected and below the 100% over-range value (1999). (Note: If the RANGE switch ends up on one of the ranges marked in red (100pF, 1nF or 10nF) it will be necessary to disconnect the unknown capacitor and adjust the C ZERO control.) Set C ZERO readout to 000 + 1 just as BELOW ZERO lamp begins to turn on. Then reconnect the unknown capacitor and read display value.

3.4.3 INDUCTANCE MEASUREMENTS

1) Set FUNCTION switch to L.

2) Set RANGE switch to 100mH.

3) Set SERIES R NULL control fully clockwise.

4) Connect unknown inductor between L/C and GND.

5) While observing the display, rotate SERIES R NULL for minimum reading. (Note: When adjusting SERIES R NULL control the Model 9400 will stop cycling if an over adjustment is made. If this happens you have gone through the null and out of the range of the measurement oscillator. Reverse direction of rotation of SERIES R NULL control and adjust for minimum reading.)

6) If reading is less than 20% of full scale, change RANGE switch to next lower range. Readjust SERIES R NULL control for minimum reading. (Note: SERIES R NULL control must be readjusted for each range change.)

7) Continue lowering range and adjusting SERIES R NULL until a reading between 20% of full scale and 100% of overrange is obtained. (Note: If the value of inductance is below 20μH make the measurement on the 100μH range since a reading of over 20% of full scale will not be obtainable.)

3.4.4 OPERATING NOTES

The following sections list several factors which will effect measurement accuracy both in and out of the circuit.

1) The following table lists the amount of series resistance which can be nulled on each inductance range.

RANGE	RESISTANCE
100μH	25Ω
1mH	130Ω
10mH	175Ω
100mH	400Ω

2) The effects of parallel resistance on an inductance measurement are listed in the following table. The values are for a 1% change in reading.

RANGE	RESISTANCE
100μH	1.2 kΩ
1mH	12 kΩ
10mH	12 kΩ
100mH	12 kΩ

3) Leads may be used for measurements and may be zeroed out in accordance with the following table on ranges printed in Red.

RANGE	LEAD CAP. MAX.
100pF	8pF
1nF	3pF
10nF	10pF

4) The following table lists the values of parallel resistance across a capacitor required to produce 1% change in reading.

RANGE	RESISTANCE
100pF	2.7 MΩ
1nF	150 kΩ
10nF	68 kΩ
100nF	68 kΩ
1 F	27 kΩ
10 F	15 kΩ
100 F	5.6 kΩ

5) The following lists the amount of resistance in series with a capacitor to produce a 1% change.

RANGE	RESISTANCE
100pF	7.5 kΩ
1nF	1 kΩ
10nF	800Ω
100nF	390Ω
1µF	140Ω
10µF	60Ω
100µF	60Ω

6) The dielectric constant of some insulating materials used in capacitors changes with frequency. This usually causes a decrease in capacity at high frequencies - an example of this is k type ceramic which will exhibit a 5% change in capacity at 100 kHz. The following table lists the approximate full scale frequency for each full range reading.

RANGE	FREQUENCY
100pF	100 kHz
1nF	75 kHz
10nF	8 kHz
100nF	2 kHz
1µF	400 Hz
10µF	66 Hz
100µF	20 Hz

CHAPTER 4
THEORY OF OPERATION

4.1 INTRODUCTION

This section includes a simplified Block Diagram, principles of operation, and a complete circuit description.

4.2 CAPACITANCE MEASUREMENTS

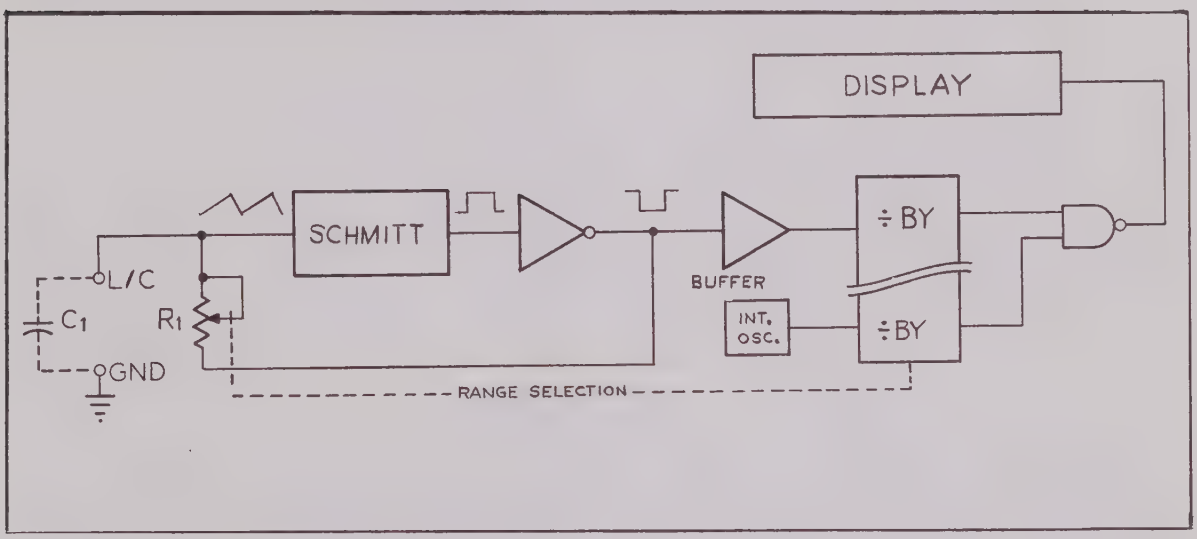


FIGURE 4.1 CAPACITANCE BLOCK DIAGRAM

A constant amplitude square wave can be produced by combining a positive feedback amplifier (Schmitt Trigger), a DC feedback amplifier, and the characteristics of an RC timing circuit. In Figure 4.1, Capacitor C_1 charges at a rate of RC until the positive trigger point of the Schmitt is reached causing it to switch states. This change of state is inverted by a unity gain amplifier and fed back to the RC time constant circuit. Capacitor C_1 now discharges again at a rate of RC, until the negative trip point of the Schmitt is reached. This process will continue and provide an output pulse train which can be related to the values of R and C. The output pulses are then buffered and divided down to be compared against a precise internal crystal controlled oscillator. The divide-by circuits are arranged to scale the output pulse train into direct capacitance readings.

As the value of C1 is changed, the frequency of the pulse train will change proportionally. Changing the value of R1 REMOTE Control is accomplished by a front panel control to accommodate various values of capacitance.

4.3 INDUCTANCE MEASUREMENTS

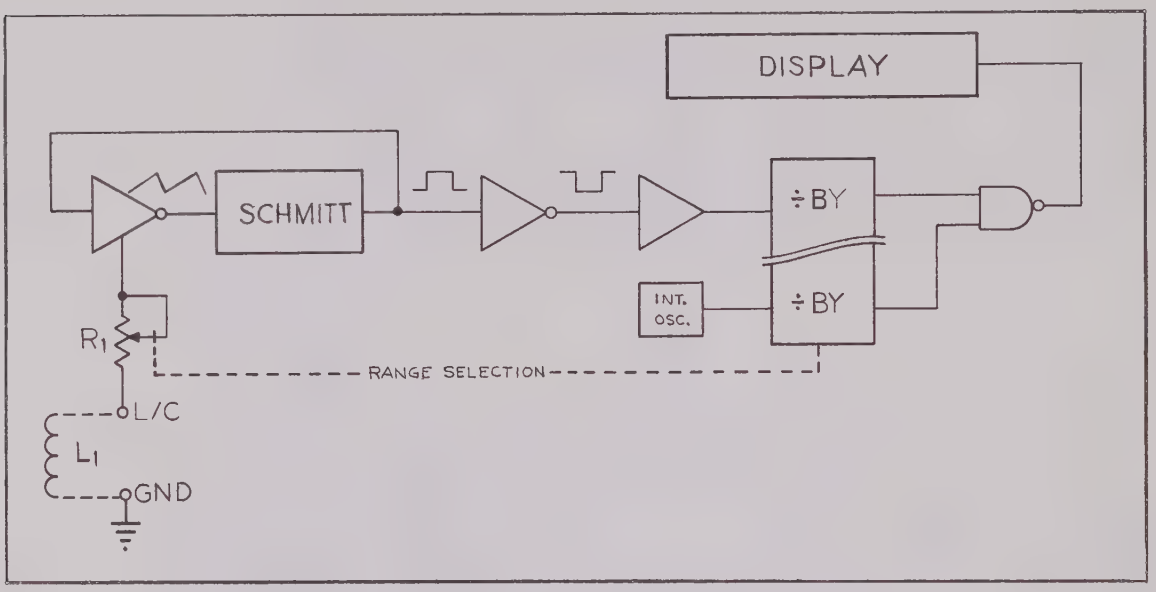


FIGURE 4.2 INDUCTANCE BLOCK DIAGRAM

The same basic procedure is followed in the inductance mode (Figure 4.2) using the characteristics of an L/R time constant. Of interest in this circuit, is our ability to null out the resistance of the coil under test. This feature allows measurement of extremely low Q coils by simply adjusting the front panel control labeled SERIES R NULL.

4.4 GUARD TERMINAL

A guard voltage is supplied at the front panel to allow true capacitance measurements of guarded instruments. The voltage and phase at the guard terminal is the same as the high side of the L/C connector for fully guarded measurements.

4.5 CIRCUIT DESCRIPTION

When making a capacitance measurement the unknown is connected between the L/C and GND terminals. The L/C terminal is connected to CR10 and CR11, which, in conjunction with CR9, CR12, R17 & R18 form a clamp circuit to prevent the input from swinging more than ±4 volts. The L/C terminal is also connected to the swinger of S2A, which, when placed in the C position connects the unknown to S2B, S3B & C, and the gate of Q5. Q5 & Q4 form a MOSFET bipolar voltage follower which provides isolation

between the measurement terminal and the GUARD terminal. S2B connects the L/C terminal to the base of Q10, an emitter follower which drives Q11 a complimentary emitter follower to provide further isolation and temperature stability. The output of Q11 drives Q33 and Q13 which form a Schmitt trigger with a threshold control R47. R47 is labeled C-DCL Level control. Q14, CR18 & Q34 form a constant current source for the Schmitt trigger providing temperature stability. The output of Q13 provides a square wave to the base of Q16 which will be discussed later in the description of inductance measure ments. Q13 also provides a square wave to R58 & CR21 (the dc level shifting network) which drives the dc amplifier Q17, Q18 and Q19 through R60. The amplifier has a dc gain control R68 labeled C FREQ control which adjusts the basic frequency of oscillation for the 100pF range. It also has a dc offset control R62 which is labeled C-SYM control. This control is used to adjust the output for a symmetrical square wave.

The square wave output of Q19 is connected to one end of a series of resistors R72, 73, 74, 75, 76, 77 and 86; the other end of which is connected to S3B. These resistors are the resistive element of the RC charge time for the oscillator. The swinger of S3B connects to the swinger of S3C which has a series of capacitors to ground (C21, C22, C23, C24 and C25). These provide the minimum capacity to maintain oscillation when no external capacity is connected.

The swinger of S3B also connects to the C position of S2B providing the positive feedback necessary to cause oscillation of the loop. C25 is connected to CR22, a variable capacitance diode, to provide for zeroing of lead capacitance on the 100pF, 1nF and 10nF ranges. This is accomplished by varying the dc bias on CR22 with R93, the C ZERO control, through R92.

The output of Q19 is also connected to the base of emitter follower Q20, through R82, which drives Q21 buffer amplifier. Integrated circuits U4, U6, U8 and U11 divide the frequency by the proper ratio for each range to read out in pF, nF, μF or μH, mH. The division for each range is listed in Table 4.1. The divided output of U12D is inverted again in U12C where the positive transient is used to synchronize the firing of the unijunction transistor Q24. Q24 fires at a rate determined by R106, C29, R104, and the sync. pulse from U12C which ensures that Q24 will fire on the close of the gate time. The negative transient from the emitter of Q24 is coupled through C30 to the inverter U14C which provides one input to the two input NAND gate U14D. The other input is provided by an inhibit reset line from the BCD output connector. With inhibit reset line at logical (1), U14D is enabled and a positive pulse from U14C generates a negative-going pulse on the output of U14D. This pulse is buffered and inverted by Q29 which drives the transfer line on the storage integrated circuits U18, U21,

U24, and U26 which store the readout between samples.

The positive transient from U12D drives the one shot Q25 and Q26 through C28 and CR24. This one shot sets a minimum time of 400 μsec between gate openings. The lead edge creates the reset pulse through the grounded base amplifier Q27 and buffer driver Q28. The reset pulse sets the count chain to zero before each sample.

The positive level out of U12D drives one input of U13A; the other input is driven by the one shot Q25 and Q26 through the inverter U13B. The sum of these two signals gives the gate time at the output of U13A. This signal is inverted by U13C and drives one input of Nand gate U13D. The other input is driven by internal clock or some division thereof, listed in Table 4.1. The summing of these two signals provides a gated chain of pulses to drive the count chain consisting of U19, U22, U25 and U27. The count chain is a series of 3 decades which divide the signal by 10 providing a BCD output (8, 4, 2, 1), and a single binary U27A which provides a full register of 1999. U27B is a binary which changes state at an indication of 2000 to indicate over range. Integrated circuits U18, U21, U24 and U26 store the information from the count chain between samples and provide for BCD output. The storage elements also drive U17, U20, U23, Q31 and Q32. U17, U20, and U23 are four to 10 line converter drivers which drive the readout indicators. Q31 transistor buffer drives the "one" in the most significant digit. Q32 transistor buffer drives the light emitting diode OFF SCALE indicator.

BELOW ZERO for the 100pF, 1nF, and 10nF ranges is detected by setting a binary U11B with the one shot Q25 and Q26 and resetting with the gate output from U13A. If the one shot time is longer than the positive output of U12D there will be no gate and the BELOW ZERO indicator will be turned on by the driver transistor Q30 which is driven by the output of U11B.

The internal oscillator is a 1 MHz crystal controlled oscillator consisting of Q22, Q23 and Y1. Q23 provides a clipped waveform to drive the integrated circuit dividers U5 and U7 which provide the proper count frequency for each range as listed in Table 4.1.

The inductance measuring circuitry consists of an L/R oscillator working in the following manner. The unknown inductor is connected between the L/C and GND terminals. The L/C terminal is connected to S3D by S2A in the L position. S3D connects the unknown in series with L1, L2, L3 or L4 depending on the range selected. These are small inductors to provide oscillation when the input terminals are shorted. The common end of L1, L2, L3, and L4 is connected to R25 the SERIES R NULL control which is connected to the emitter of Q6 a transistor amplifies. The collector of Q6 drives the emitter followers Q7 and Q8 which drives the dc level shifting network R35, R36 and CR16. The swinger

of R36 (L SYMMETRY control) is connected to the base of Q10 through S2B. Q10 and Q11 are complimentary emitter followers which drive the Schmitt Q12 and Q13. The output of Q13 drives the emitter follower Q16 through R57. Q16 drives Q15, another emitter follower, to provide thorough isolation. The output of Q15 drives the level shifting network on L frequency control R52, R53, CR20 and R54. R54 (L FREQ control) controls the amplitude of the signal while R53 (L-DC level control) sets the dc level of the signal. The swinger of R53 drives emitter follower Q9 whose output drives the base of Q6, completing the loop and providing the necessary positive feedback for oscillation.

The output of Q13 is fed through the unity gain amplifier as in the capacity measuring circuit and out of Q20 to the divide chain to produce the proper gate time for the various ranges.

TABLE 4.1 LIST OF OSCILLATOR DIVISORS

RANGE L	RANGE C	RC OR L/R DIVISOR OF OSC. FREQUENCY	INT. OSC. FREQ. COUNTED
100µH	100pF	200	1 MHz
1mH	1nF	1000	100 kHz
10mH	10nF	1000	10 kHz
100mH	100nF	400	10 kHz
	1µf	80	10 kHz
	10µF	8	10 kHz
	100µF	4	10 kHz

4.6 POWER SUPPLY

The Model 9400 uses three regulated power supplies and one unregulated supply.

+200V

The +200V used for the anode voltage of the readout is obtained by half wave rectifying the high voltage secondary pins 5 and 6 of T1. CR1 is the rectifier, C2 is the capacitance input filter.

+5V, +12V, -12V

The three regulated supplies +5V, +12V, and -12V utilize the same regulation principle so only one will be discussed in this section. The +5V dc is obtained by a full wave bridge rectifying a center-tapped secondary, pins 7, 8 and 9 of T1. CR2 and CR3 form the full wave rectifier which drives the capacitance filter C3 producing an unregulated +9V dc. This is connected to U1 and Q1. U1 is an integrated circuit voltage regulator which drives the series-pass transistor Q1. R4 (+5V adjust) sets the output to +5 volts. The Model 9400 uses the integrated circuit voltage regulator due to the excellent load regulation and temperature characteristics. Similarly R9 is the +12V adjustment and R14 is the -12V adjustment.

CHAPTER 5
MAINTENANCE AND CALIBRATION

5.1 INTRODUCTION

This chapter provides information for maintaining the factory new performance of the Model 9400 L/C Meter. The following sections are included: Factory service, test equipment, calibration procedures, and board repair.

5.2 FACTORY SERVICE

Whenever the Model 9400 requires service beyond the scope of this description, the nearest Systron-Donner Representative should be contacted to provide field service or arrange factory returns when necessary. Address inquiries on operation or application to your nearest sales representative. All other inquiries should be made to: Sales Manager, Concord Instrument Division, Systron-Donner Corporation, 888 Galindo Street, Concord, California 94520. Be sure to specify the complete model and serial number in all correspondence.

5.3 TEST EQUIPMENT

The major portion of the Model 9400 servicing and calibration can be performed using the following pieces of test equipment:

1) Oscilloscope - Tektronix 533
2) Digital Voltmeter - S-D Model 9000
3) Inductance Standards - (.1% value series resonant) 100μH, 1mH, 10mH, 100mH.
4) Capacitance Standards - (.1% values) 100pF, 1nF, 10nF, 100nF, 1μF, 10μF, 100μF.

5.4 CALIBRATION PROCEDURE

The procedure for calibrating the Model 9400 requires a 1 hour warm-up prior to bottom cover removal.

5.4.1 POWER SUPPLY ADJUSTMENT

1) Remove the two retaining screws from the bottom cover and remove the cover.
2) With DVM, monitor -12V line (emitter of Q3) and adjust to -12V ±10mV.
3) Monitor +12V line(emitter of Q2)and adjust to +12V ±10mV.

4) Monitor +5V line(emitter of Q1) and adjust to +5V ±10mV.

5) Set unit upright on bottom cover before continuing alignment.

5.4.2 CAPACITANCE ALIGNMENT PROCEDURE

1) Set RANGE switch to 100pF.

2) Set FUNCTION switch to C.

3) With DVM, monitor the L/C terminal input for 0V ±20mV.

4) If the unit requires adjustment lift unit up from front and adjust C-DC level (R47) to 0V ±20mV.

5) Monitor GUARD terminal with oscilloscope. Adjust C-SYM control (R62) for symmetrical signal.

5.4.3 RANGE ADJUSTMENT

1) Adjust C ZERO on front panel to 000 + 1 or below zero indication.

2) Connect a 100pF standard to L/C and GND terminals. The unit should read 100.0pF ±1.0pF. Adjust R68 (C FREQ control) for proper indication if required. Repeat, if necessary step 1.

3) Change RANGE switch to 1nF and check C ZERO set for an indication of 000 + 1 or below zero.

4) Connect a 1nF standard to L/C and GND terminals. The indication should be 1.000nF ±.010nF. Adjust R77 for proper indication, if required.

5) Change RANGE switch to 10nF and set C ZERO.

6) Connect a 10nF standard to L/C and GND terminals and observe an indication of 10.00nF ±.1nF. Adjust R76 for proper indication if required.

7) Change RANGE switch to 100nF range (Note: Disregard BELOW ZERO indication on all ranges printed in black.)

8) Connect a 100nF standard and observe an indication of 100.0 nF ±1.0nF. Adjust R75 for proper indication, if required.

9) Change RANGE switch to 1µF range.

10) Connect a 1µF standard and observe an indication of 1.000µF ±.010µF. Adjust R74 for proper indication, if required.

11) Change RANGE switch to 10µF range.

12) Connect a 10µF standard and observe an indication of 10.00µF ±.1µF. If adjustment is required adjust R73 for proper indication.

13) Change RANGE switch to 100µF range.

14) Connect a 100µF standard and observe an indication of 100.0µF ±1.0µF. Adjust R72 for proper indication, if required.

5.4.4 INDUCTANCE ALIGNMENT PROCEDURE

1) Set RANGE switch to 100mH and FUNCTION switch to L.
2) Connect an oscilloscope to GUARD terminal.
3) Place a jumper between L/C and GND terminals.
4) Rotate SERIES R NULL control clockwise. Observe maximum frequency, on oscilloscope, at approximately 10° from maximum clockwise position. Adjust L-DC control (R53) for this condition, if necessary.
5) Adjust L SYMMETRY, control R36, for symmetrical system.

5.4.5 RANGE ADJUSTMENT

1) Set RANGE switch to the 100µH range.
2) Jumper L/C and GND terminals.
3) Adjust SERIES R NULL for minimum indication which should be approximately 15° from the counter clockwise end of rotation. The indication should be 000 ± 1. Adjust L4 for proper indication, if necessary.
4) Remove jumper from L/C and GND terminals and connect the 100µH standard. Adjust SERIES R NULL for a minimum indication. Observe an indication of 100.0µH ±1.0µH. Adjust R54 (L frequency control) for proper indication if necessary. (Note: If adjustment of full scale was necessary recheck zero for proper adjustment.)
5) Change RANGE switch to 1mH range and jumper L/C and GND terminals.
6) Adjust SERIES R NULL for a minimum indication of .000mH ±.001mH. If adjustment is required adjust L3 for proper indication.
7) Remove jumper and replace with 1mH standard and adjust SERIES R NULL for a minimum reading. Observe an indication of 1.000mH ±.010mH. Adjust R31 for proper indication, if required.
8) Change RANGE switch to 10mH.
9) Connect a 10mH standard, adjust SERIES R NULL for a minimum indication of 10.00mH ±0.10mH. Adjust R30 for proper indication, if required.
10) Change RANGE switch to 100mH range.
11) Connect a 100mH standard and adjust SERIES R NULL for a minimum indication of 100.0mH ±1.0mH. Adjust R29 for proper indication, if required.

5.5 BOARD REPAIR PROCEDURES

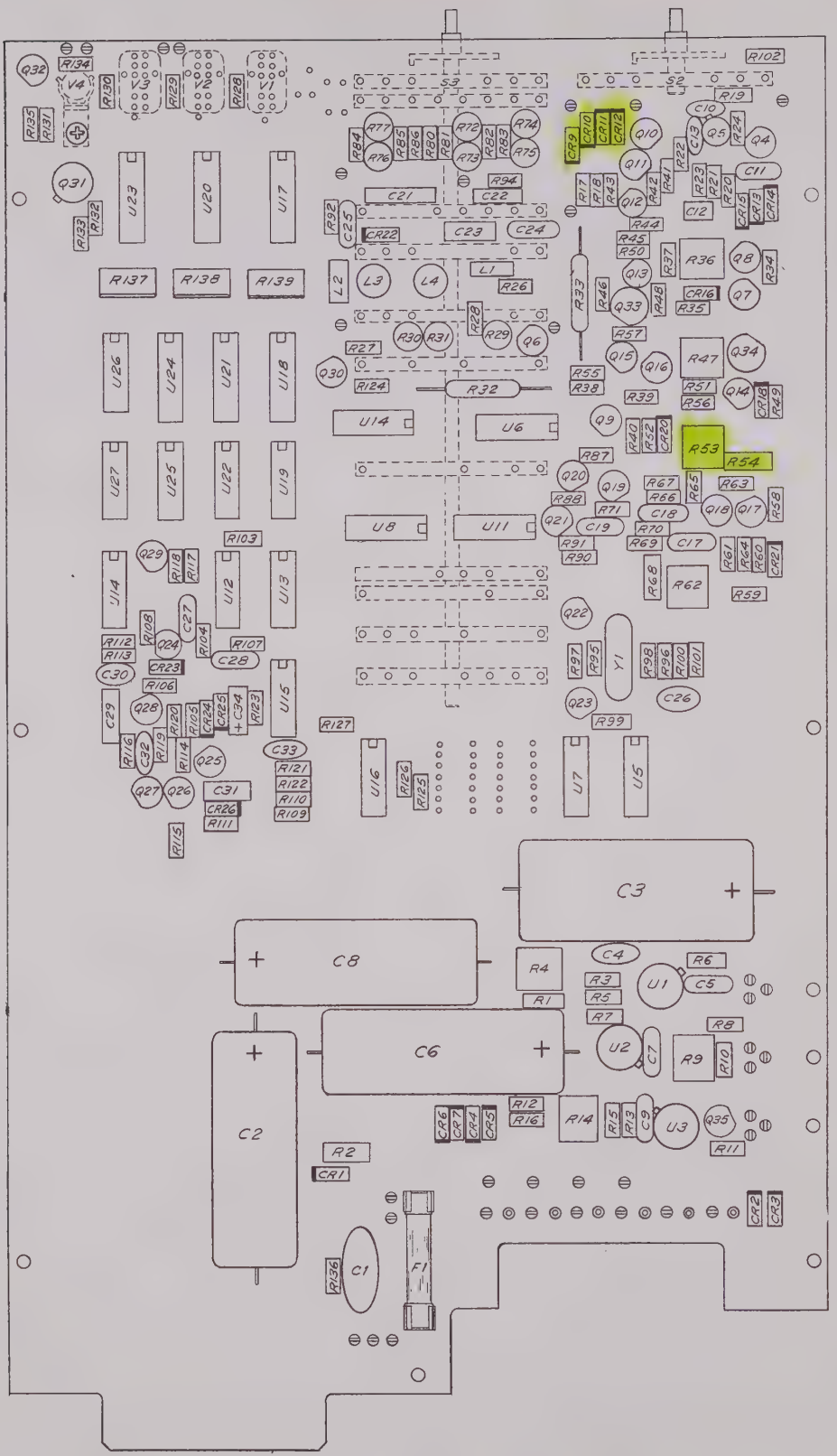
To remove a part on a printed circuit board, cut the lead of the component near the body of the component. Using a low power (40 watts or less) soldering instrument, apply heat to each cut lead. As soon as the solder melts slip lead from the hole; then clean the hole with a toothpick. Clean the board surface with Freon since any flux left on the board can absorb moisture and cause a meter malfunction. Form the tinned leads of the replacement part and insert it in clean holes, trimming leads to extend 1/16 inch beyond the back surface of the board. Only 63-37 solder with a maximum diameter of 1/16 inch should be used to solder the leads to the board using a hemostat, long nosed pliers, or other heat sink on all leads of all semiconductor devices and quarter-watt resistors. Allow the soldered junction to cool before removing the heat sink. NEVER unnecessarily remove or replace an integrated circuit package.

CHAPTER 6
DRAWINGS AND PARTS LIST

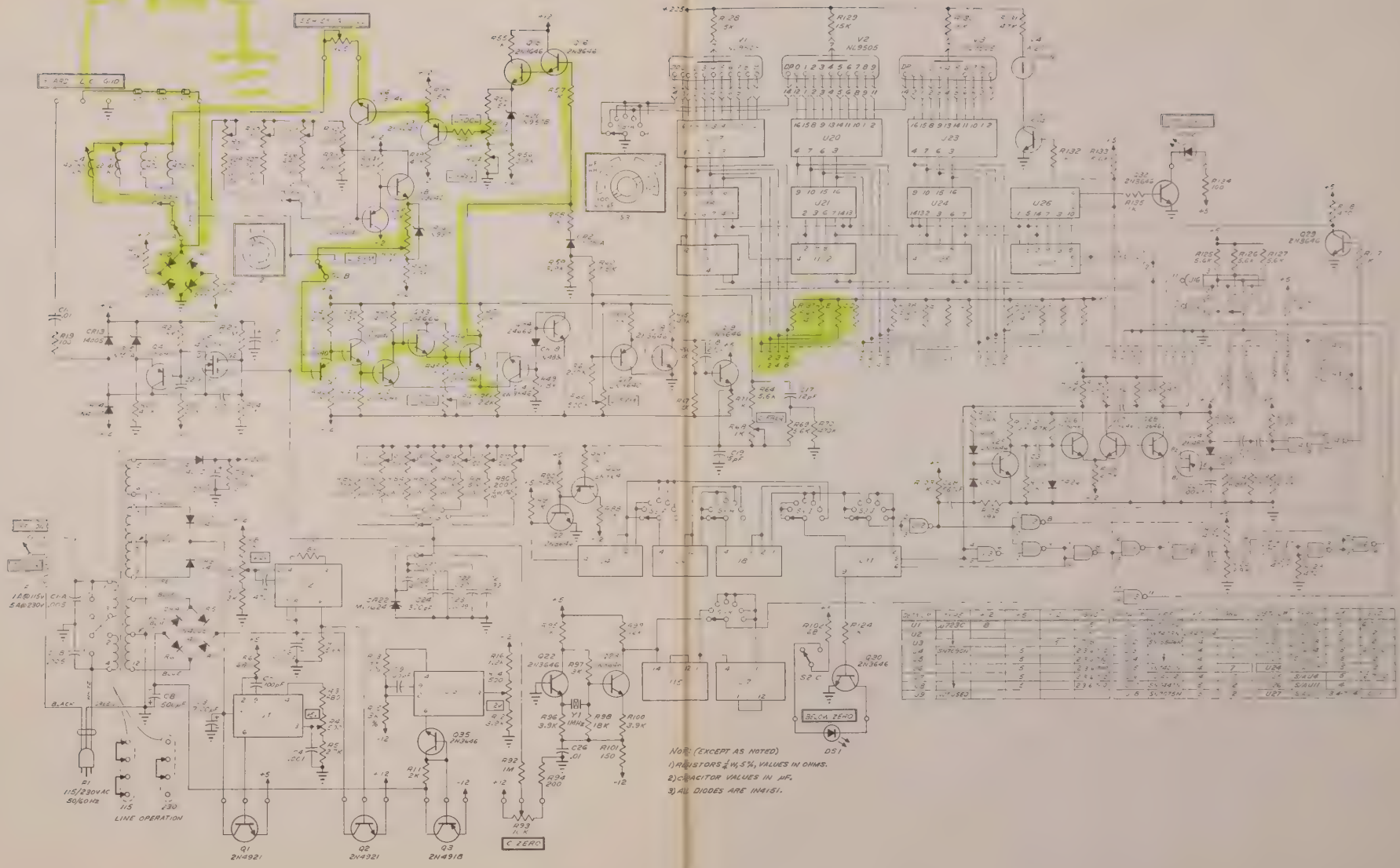
6.1 INTRODUCTION

This section contains the drawings and parts list for the Model 9400 L/C Meter. The following drawings are included:

L/C Meter P.C. Assembly	D33913R2
L/C Meter & P.C. Assembly Schematic	D33910R2



L/C METER P.C. ASSEMBLY D33913R2



L/C METER & P.C. ASSEMBLY SCHEMATIC D33910R2

L/C METER FINAL ASSEMBLY PARTS LIST

REF.	DESCRIPTION	SD PART NO.
DS1	Diode, Light Emitting	CR0367
DS2	Diode, Light Emitting	CR0367
L5	Bead, Ferrite	H0654
L6	Bead, Ferrite	H0654
L7	Bead, Ferrite	H0654
P1	Cord, Line	W0088
Q1	Transistor, 2N4921	Q0267
Q2	Transistor, 2N4921	Q0267
Q3	Transistor, 2N4918	Q0268
R25	Resistor, 500Ω, Pot	R2616
R93	Resistor, 10k, Pot	R2615
S1	Switch, Slide (Power)	05034990
T1	Transformer, Power	39032

L/C METER P.C. ASSEMBLY PARTS LIST

REF.	DESCRIPTION	SD PART NO.
	L/C Meter P.C. Assembly	D33913R2
	L/C Meter P.C. Schematic	D33910R2
C1	Capacitor, .005μF, 1kV	03289940
C2	Capacitor, 20μF, 350V, Elect	C1094
C3	Capacitor, 7100μF, 10V, Elect	C1188
C4	Capacitor, .001μF, 1kV, Disc.	C0235
C5	Capacitor, 100pF, 500V, D.M.	C0536
C6	Capacitor, 500μF, 30V, Elect	C1134
C7	Capacitor, 470pF, 300V, D.M.	C0542
C8	Capacitor, 500μF, 30V, Elect	C1134
C9	Capacitor, 100pF, 500V, D.M.	C0536
C10	Capacitor, .01μF, 100V, Disc.	C0556
C11	Capacitor, 22pF, 500V, D.M.	C0529
C12	Capacitor, 1μF, 25V, Disc.	C0879
C13	Capacitor, .001μF, 1kV, Disc.	C0235
C14	Not Used	
C15	Not Used	
C16	Not Used	
C17	Capacitor, 12pF, 500V, D.M	C0637
C18	Capacitor, 27pF, 500V, D.M.	C0530
C19	Capacitor, 15pF, 500V, D.M.	C0528
C20	Not Used	
C21	Capacitor, .39μF, 100V, Met Mylar	C1237
C22	Capacitor, .039μF, 100V, Met Mylar	C1238
C23	Capacitor, .0039μF, 200V, Mylar	C1239
C24	Capacitor, 390pF, 500V	C0541
C25	Capacitor, 470pF, 300V, D.M.	C0542
C26	Capacitor, .01μF, 100V, Disc.	C0556
C27	Capacitor, 100pF, 500V, D.M.	C0536
C28	Capacitor, 560pF, 300V, D.M.	C1079
C29	Capacitor, .1μF, Mylar	C0734
C30	Capacitor, .01μF, 100V, Disc.	C0556
C31	Capacitor, .033μF, 100V, Met Mylar	
C32	Capacitor, .001μF, 1kV, Disc.	C0235
C33	Capacitor, .001μF, 1kV, Disc.	C0235
C34	Capacitor, 47μF, 10V, Tant	C1089

L/C METER P.C. ASSEMBLY PARTS LIST (Con't.)

REF.	DESCRIPTION	SD PART NO.
CR1	Diode, IN4005	CR0284
CR2	Diode, IN4005	CR0284
CR3	Diode, IN4005	CR0284
CR4	Diode, IN4005	CR0284
CR5	Diode, IN4005	CR0284
CR6	Diode, IN4005	CR0284
CR7	Diode, IN4005	CR0284
CR8	Not Used	
CR9	Diode, 19330	19330
CR10	Diode, IN4151	CR0150
CR11	Diode, IN4151	CR0150
CR12	Diode, 19330	19330
CR13	Diode, IN4005	CR0284
CR14	Diode, IN4005	CR0284
CR15	Diode, IN751A	CR0095
CR16	Diode, IN937	CR0109
CR17	Not Used	
CR18	Diode, IN4830	CR0361
CR19	Not Used	
CR20	Diode, IN957B	CR0292
CR21	Diode, IN751A	CR0095
CR22	Diode, MV1624	CR0353
CR23	Diode, IN4151	CR0150
CR24	Diode, IN4151	CR0150
CR25	Diode, IN4151	CR0150
CR26	Diode, IN4151	CR0150
F1	Fuse, 1 Amp, 3AG	F0005
L1	Inductor, 470mH	L0019
L2	Inductor, 47mH	L0074
L3	Inductor, 22-41μH, Adjustable	L0170
L4	Inductor, 43-85μH, Adjustable	L0171
Q1	Not Used	
Q2	Not Used	
Q3	Not Used	
Q4	Transistor, 2N3640	Q0178
Q5	Transistor, 40673	Q0297
Q6	Transistor, 2N3646	Q0218
Q7	Transistor, 2N3640	Q0178
Q8	Transistor, 2N3646	Q0218
Q9	Transistor, 2N3640	Q0178
Q10	Transistor, 2N3640	Q0178

L/C METER P.C. ASSEMBLY PARTS LIST (Con't.)

REF.	DESCRIPTION	SD PART NO.
Q11	Transistor, 2N3646	Q0218
Q12	Transistor, 2N3646	Q0218
Q13	Transistor, 2N3646	Q0218
Q14	Transistor, 2N3646	Q0218
Q15	Transistor, 2N3646	Q0218
Q16	Transistor, 2N3646	Q0218
Q17	Transistor, 2N3640	Q0178
Q18	Transistor, 2N3646	Q0218
Q19	Transistor, 2N3646	Q0218
Q20	Transistor, 2N3640	Q0178
Q21	Transistor, 2N3646	Q0218
Q22	Transistor, 2N3646	Q0218
Q23	Transistor, 2N3646	Q0218
Q24	Transistor, 2N4870	Q0266
Q25	Transistor, 2N3646	Q0218
Q26	Transistor, 2N3646	Q0218
Q27	Transistor, 2N3646	Q0218
Q28	Transistor, 2N3646	Q0218
Q29	Transistor, 2N3646	Q0218
Q30	Transistor, 2N3646	Q0218
Q31	Transistor, 15840	15840
Q32	Transistor, 2N3646	Q0218
Q33	Transistor, S24666	26004961
Q34	Transistor, S24666	26004961
Q35	Transistor, 2N3646	Q0218
R1	Resistor, 5.6k, 1/4W, 5%	R0821
R2	Resistor, 270k, 1/2W, 5%	R0147
R3	Resistor, 680Ω, 1/4W, 5%	R1234
R4	Resistor, 360T, 500Ω, Pot	R2617
R5	Resistor, 2.7k, 1/4W, 5%	R0937
R6	Resistor, 680Ω, 1/4W, 5%	R1234
R7	Resistor, 1.8k, 1/4W, 5%	R0959
R8	Resistor, 2k, 1/4W, 5%	R0734
R9	Resistor, 1k, Pot 360T	R2629
R10	Resistor, 3k, 1/4W, 5%	R0711
R11	Resistor, 2k, 1/4W, 5%	R0734
R12	Resistor, 3.9k, 1/4W, 5%	R0939
R13	Resistor, 3.01k, 1/4W, 1%	R2338
R14	Resistor, 500Ω, Pot, 360%	R2617
R15	Resistor, 3.01k, 1/4W, 1%	R2338

L/C METER P.C. ASSEMBLY PARTS LIST (Con't.)

REF.	DESCRIPTION	SD PART NO.
R16	Resistor, 1.2k, 1/4W, 5%	R0809
R17	Resistor, 15k, 1/4W, 5%	R0728
R18	Resistor, 15k, 1/4W, 5%	R0728
R19	Resistor, 100Ω, 1/4W, 5%	R0966
R20	Resistor, 4.7k, 1/4W, 5%	R0892
R21	Resistor, 1.5k, 1/4W, 5%	R0783
R22	Resistor, 2.7k, 1/4W, 5%	R0937
R23	Resistor, 5.1M, 1/4W, 5%	02355500
R24	Resistor, 1M, 1/4W, 5%	R0962
R25	Not Used	
R26	Resistor, MF 649Ω, RN55F, 1/10W, 1%	R2618
R27	Resistor, MF 221Ω, RN55F, 1/10W, 1%	R2622
R28	Resistor, MF 221Ω, RN55F, 1/10W, 1%	R2622
R29	Resistor, 100Ω, Pot 340 Equiv.	R2374
R30	Resistor, 50Ω, Pot 340 Equiv.	R2369
R31	Resistor, 50Ω, Pot 340 Equiv.	R2369
R32	Resistor, 100Ω, RN65D, 1W, 1/2%	R2620
R33	Resistor, 150Ω, RN65D, 1W, 1/2%	R2619
R34	Resistor, 5.6k, 1/4W, 5%	R0821
R35	Resistor, 1.2k, 1/4W, 5%	R0809
R36	Resistor, 1k, Pot 360T	R2629
R37	Resistor, 3.3k, 1/4W, 5%	R0742
R38	Resistor, 15k, 1/4W, 5%	R0728
R39	Resistor, 4.7k, 1/4W, 5%	R0892
R40	Resistor, 3.3k, 1/4W, 5%	R0742
R41	Resistor, 120k, 1/4W, 5%	R0807
R42	Resistor, 10k, 1/4W, 5%	R0766
R43	Resistor, 1.2k, 1/4W, 5%	R0809
R44	Resistor, 5.6k, 1/4W, 5%	R0821
R45	Resistor, 470Ω, 1/4W, 5%	R1044
R46	Resistor, 1k, 1/4W, 5%	R0765
R47	Resistor, 500Ω, Pot 360T	R2617
R48	Resistor, 1k, 1/4W, 5%	R0765
R49	Resistor, 1.8k, 1/4W, 5%	R0959
R50	Resistor, 1k, 1/4W, 5%	R0765
R51	Resistor, 2.2k, 1/4W, 5%	R0749
R52	Resistor, 1.5k, 1/4W, 5%	R0783
R53	Resistor, 500Ω, Pot 360T	R2617
R54	Resistor, 1k, Pot 66P	R2630
R55	Resistor, 1k, 1/4W, 5%	R0765

L/C METER P.C. ASSEMBLY PARTS LIST (Con't.)

REF.	DESCRIPTION	SD PART NO.
R56	Resistor, 2.2k, 1/4W, 5%	R0749
R57	Resistor, 1k, 1/4W, 5%	R0765
R58	Resistor, 1k, 1/4W, 5%	R0765
R59	Resistor, 3.9k, 1/4W, 5%	R0939
R60	Resistor, 7.5k, 1/4W, 5%	R0884
R61	Resistor, 220k, 1/4W, 5%	R0967
R62	Resistor, 500k, Pot 360T	R2628
R63	Resistor, 15k, 1/4W, 5%	R0728
R64	Resistor, 5.6k, 1/4W, 5%	R0821
R65	Resistor, 4.7k, 1/4W, 5%	R0892
R66	Resistor, 2k, 1/4W, 5%	R0734
R67	Resistor, 15k, 1/4W, 5%	R0728
R68	Resistor, 1k, Pot 66P	R2630
R69	Resistor, 5.6k, 1/4W, 5%	R0821
R70	Resistor, 470Ω, 1/4W, 5%	R1044
R71	Resistor, 1k, 1/4W, 5%	R0765
R72	Resistor, 50Ω, Pot 340 Equiv.	R2369
R73	Resistor, 50Ω, Pot 340 Equiv.	R2369
R74	Resistor, 100Ω, Pot 340 Equiv.	R2374
R75	Resistor, 100Ω, Pot 340 Equiv.	R2374
R76	Resistor, 500Ω, Pot 340 Equiv.	R2448
R77	Resistor, 500Ω, Pot 340 Equiv.	R2448
R78	Not Used	
R79	Not Used	
R80	Resistor, MF 196Ω, RN55D, 1/10W, 1%	R2623
R81	Resistor, MF 511Ω, RN55D, 1/10W, 1%	R2621
R82	Resistor, MF 1.02k, RN55D, 1/10W, 1%	R2625
R83	Resistor, MF 2.05k, RN55D, 1/10W, 1%	R2624
R84	Resistor, MF 4.87k, RN55D, 1/10W, 1%	R2626
R85	Resistor, MF 4.87k, RN55D, 1/10W, 1%	R2626
R86	Resistor, MF 25.5k, RN55D, 1/10W, 1%	R2627
R87	Resistor, 1k, 1/4W, 5%	R0765
R88	Resistor, 10k, 1/4W, 5%	R0766
R89	Not Used	
R90	Resistor, 8.2k, 1/4W, 5%	R0883
R91	Resistor, 1k, 1/4W, 5%	R0765
R92	Resistor, 1M, 1/4W, 5	R0962
R93	Not Used	
R94	Resistor, 200Ω, 1/4W, 5%	R0736
R95	Resistor, 1k, 1/4W, 5%	R0765

L/C METER P.C. ASSEMBLY PARTS LIST (Con't.)

REF.	DESCRIPTION	SD PART NO.
R96	Resistor, 3.9k, 1/4W, 5%	R0939
R97	Resistor, 3k, 1/4W, 5%	R0711
R98	Resistor, 18k, 1/4W, 5%	R0785
R99	Resistor, 1.2k, 1/4W, 5%	R0809
R100	Resistor, 3.9k, 1/4W, 5%	R0939
R101	Resistor, 150Ω, 1/4W, 5%	R0983
R102	Resistor, 68Ω, 1/4W, 5%	R1426
R103	Resistor, 1k, 1/4W, 5%	R0765
R104	Resistor, 6.8M, 1/4W, 5%	R2306
R105	Resistor, 39k, 1/4W, 5%	R0748
R106	Resistor, 33M, 1/4W, 5%	R0552
R107	Resistor, 5.6k, 1/4W, 5%	R0821
R108	Resistor, 150Ω, 1/4W, 5%	R0983
R109	Resistor, 1.2k, 1/4W, 5%	R0809
R110	Resistor, 1k, 1/4W, 5%	R0765
R111	Resistor, 47k, 1/4W, 5%	R0777
R112	Resistor, 5.6k, 1/4W, 5%	R0821
R113	Resistor, 6.8k, 1/4W, 5%	R0696
R114	Resistor, 15k, 1/4W, 5%	R0728
R115	Resistor, 2.7k, 1/4W, 5%	R0937
R116	Resistor, 12k, 1/4W, 5%	R0759
R117	Resistor, 1k, 1/4W, 5%	R0765
R118	Resistor, 470Ω, 1/4W, 5%	R1044
R119	Resistor, 5.6k, 1/4W, 5%	R0821
R120	Resistor, 470Ω, 1/4W, 5%	R1044
R121	Resistor, 4.7k, 1/4W, 5%	R0892
R122	Resistor, 3.9k, 1/4W, 5%	R0939
R123	Resistor, 470Ω, 1/4W, 5%	R1044
R124	Resistor, 1k, 1/4W, 5%	R0765
R125	Resistor, 5.6k, 1/4W, 5%	R0821
R126	Resistor, 5.6k, 1/4W, 5%	R0821
R127	Resistor, 5.6k, 1/4W, 5%	R0821
R128	Resistor, 15k, 1/4W, 5%	R0728
R129	Resistor, 15k, 1/4W, 5%	R0728
R130	Resistor, 15k, 1/4W, 5%	R0728
R131	Resistor, 47k, 1/4W, 5%	R0777
R132	Resistor, 1k, 1/4W, 5%	R0765
R133	Resistor, 5.6k, 1/4W, 5%	R0821
R134	Resistor, 100Ω, 1/4W, 5%	R0966
R135	Resistor, 1k, 1/4W, 5%	R0765
R136	Resistor, 1k, 1/4W, 5%	R0765

L/C METER P.C. ASSEMBLY PARTS LIST (Con't.)

REF.	DESCRIPTION	SD PART NO.
R137	Resistor, Network 5.6k	27867
R138	Resistor, Network 5.6k	27867
R139	Resistor, Network 5.6k	27867
U1	Integrated Circuit, μ723C	25756
U2	Integrated Circuit, μ723C	25756
U3	Integrated Circuit, μ723C	25756
U4	Integrated Circuit, SN7090N	25732
U5	Integrated Circuit, SN7090N	25732
U6	Integrated Circuit, SN7090N	25732
U7	Integrated Circuit, SN7090N	25732
U8	Integrated Circuit, SN7090N	25732
U9	Option	
U10	Option	
U11	Integrated Circuit, SN7473N	19709
U12	Integrated Circuit, SN15846N	19716
U13	Integrated Circuit, SN15846N	19716
U14	Integrated Circuit, SN15846N	19715
U15	Integrated Circuit, SN7400N	19705
U16	Integrated Circuit, SN15846N	19716
U17	Integrated Circuit, SN7441N	19707
U18	Integrated Circuit, SN7075N	25731
U19	Integrated Circuit, SN7090N	25732
U20	Integrated Circuit, SN7441N	19707
U21	Integrated Circuit, SN7075N	25731
U22	Integrated Circuit, SN7090N	25732
U23	Integrated Circuit, SN7441N	19707
U24	Integrated Circuit, SN7075N	25731
U25	Integrated Circuit, SN7090N	25732
U26	Integrated Circuit, SN7473N	19709
U27	Integrated Circuit, SN7473N	19709
V1	Readout Tube, NL9505	V0130
V2	Readout Tube, NL9505	V0130
V3	Readout Tube, NL9505	V0130
V4	Lamp Neon, A-Z61	I0082
Y1	Crystal, 1 MHz	Y0019
S1	Not Used	
S2	Rotary Switch, PC Mount (Functions)	B33906
S3	Rotary Switch, PC Mount (Range)	B33905

APPENDIX A
MODEL 9400
Ser. 186-up

Make the following text changes and additions to the Model 9400 L/C METER manual for serial numbered units 186 and up:

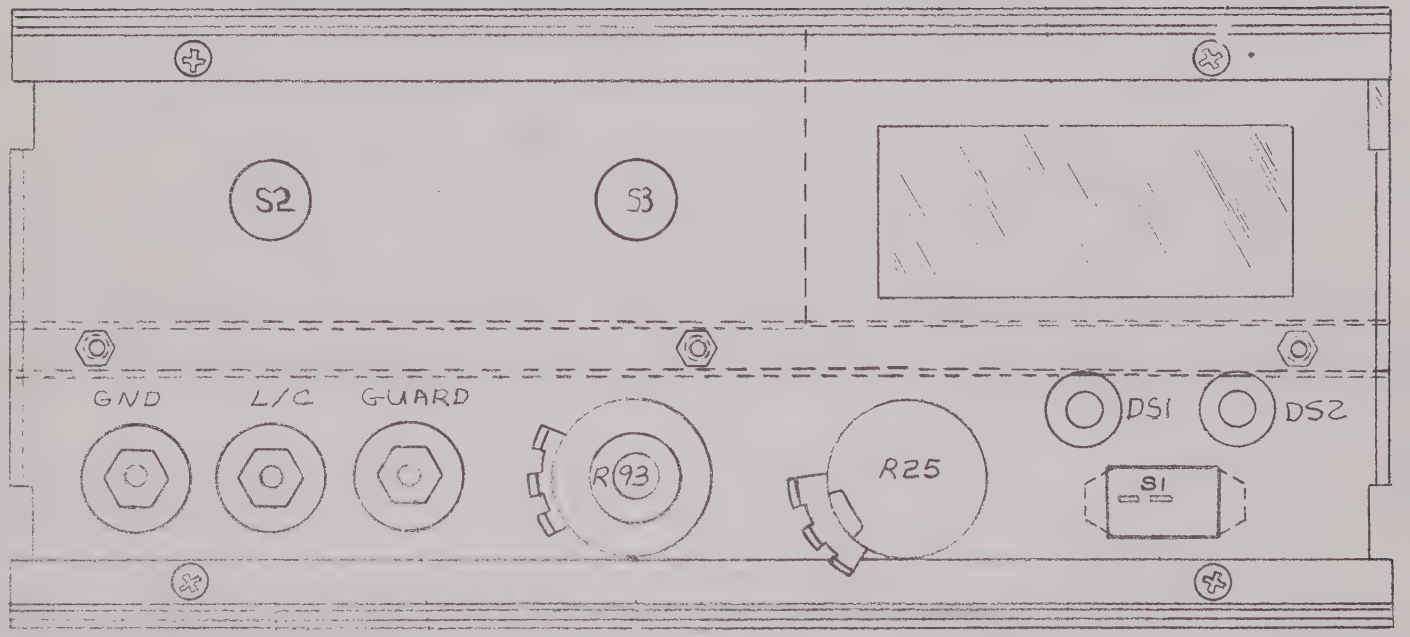
Page 3-5

Change section 3.4.3 paragraph 5) to read:

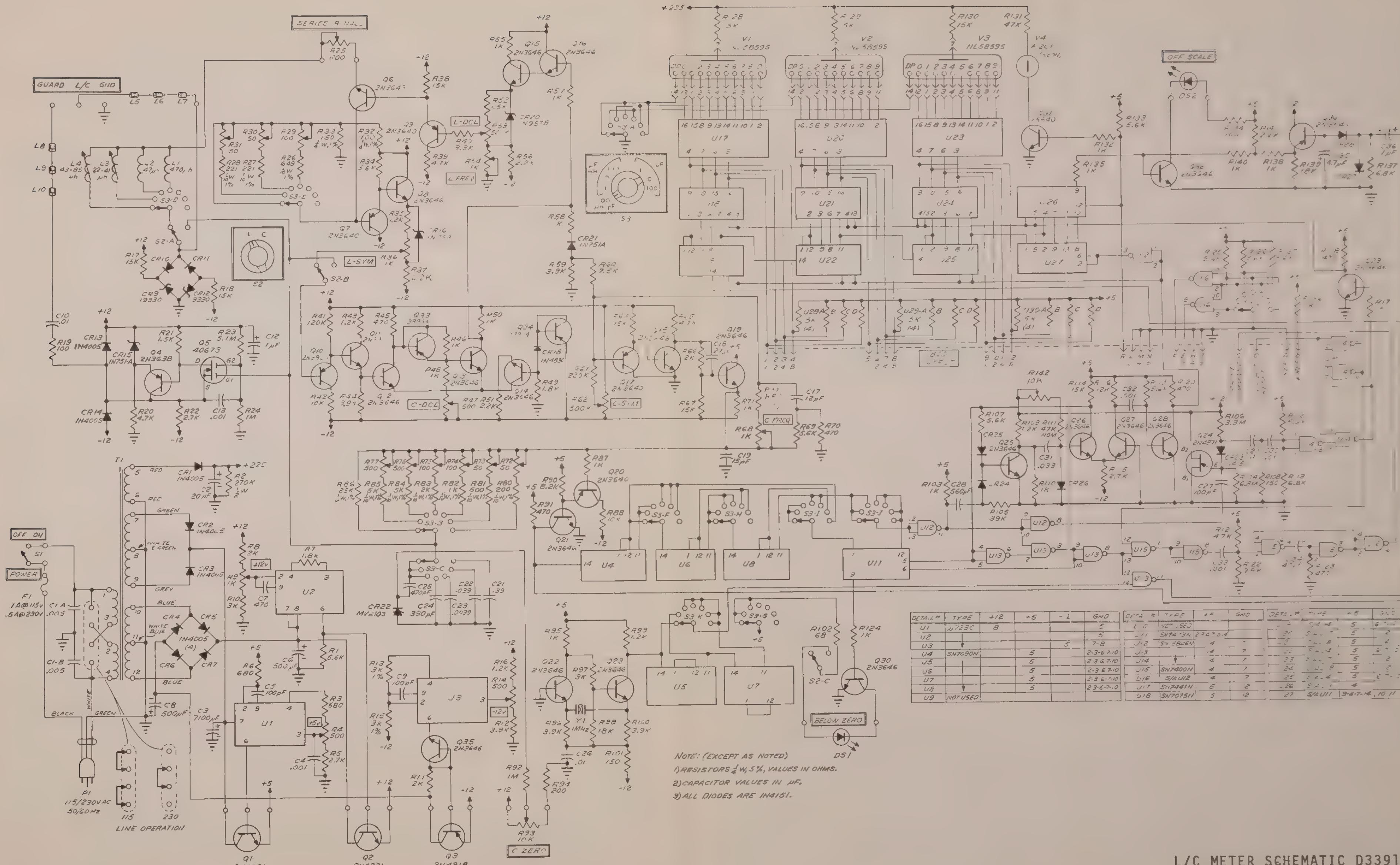
5) While observing the display, rotate SERIES R NULL for minimum reading. (Note: When adjusting SERIES R NULL control the Model 9400 will stop cycling if an over adjustment is made. If this happens, you have gone through the null, out of the range of the measurement oscillator, and the OFF SCALE indicator will light. Reverse the direction of rotation of the SERIES R NULL control and adjust for a minimum reading.)

Drawings and parts lists included:

FRONT PANEL ASSEMBLY C39397B
L/C METER SCHEMATIC D33910C
L/C METER TEST ASSEMBLY D39399B
L/C METER P.C. ASSEMBLY D33913C



L/C METER FRONT PANEL ASSEMBLY C39397B



DETAIL #	TYPE	+12	+5	-12	GND
U1	µA723C	8			5
U2	↓				5
U3	↓			5	7-8
U4	SN7090N		5		2-3-6-7-10
U5			5		2-3-6-7-10
U6			5		2-3-6-7-10
U7			5		2-3-6-7-10
U8	↓		5		2-3-6-7-10
U9	NOT USED				

DETAIL #	TYPE	+5	GND
U10	NOT USED		
U11	[illegible]	2-3-4-7-9-14	
U12	[illegible]	4	
U13		14	7
U14	↓	4	7
U15	SN7400N	4	7
U16	S/A U12	4	7
U17	SN7441N	5	2
U18	SN7075N	5	12

DETAIL #	TYPE	+5	GND
[illegible]	[illegible]	5	[illegible]
[illegible]	[illegible]	5	2
[illegible]	[illegible]	5	2
[illegible]	[illegible]	5	[illegible]
23	[illegible]	5	2
24	[illegible]	5	2
25	[illegible]	5	[illegible]
26	[illegible]	4	
27	S/A U11	3-4-7-14	10 11

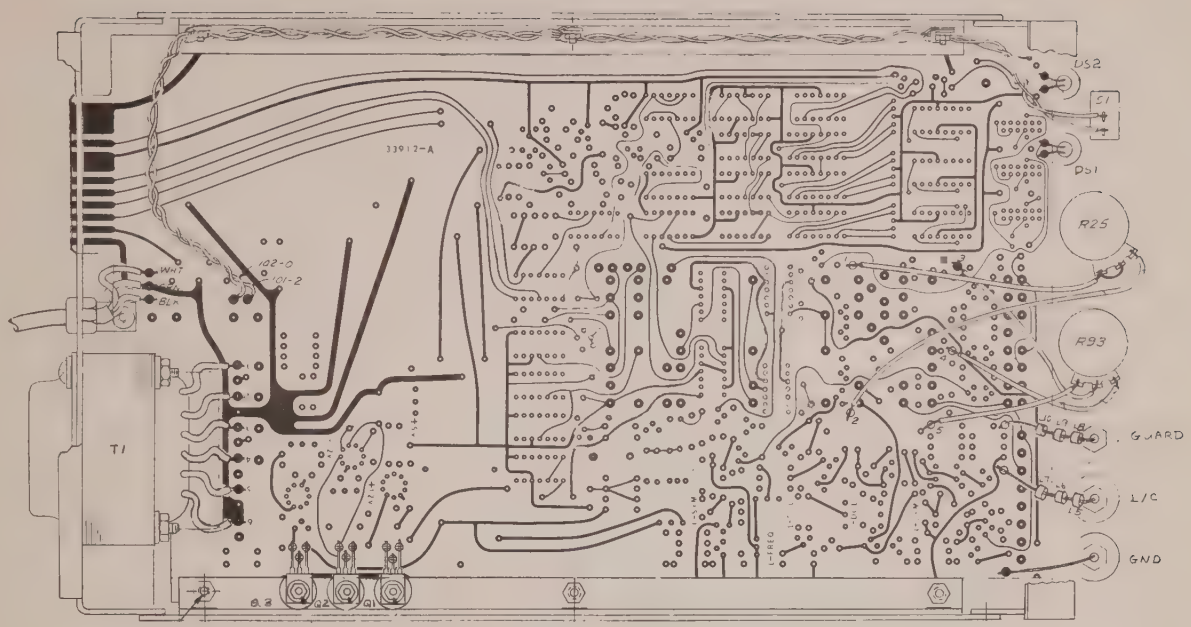
NOTE: (EXCEPT AS NOTED)

1) RESISTORS 1/4 W, 5%, VALUES IN OHMS.

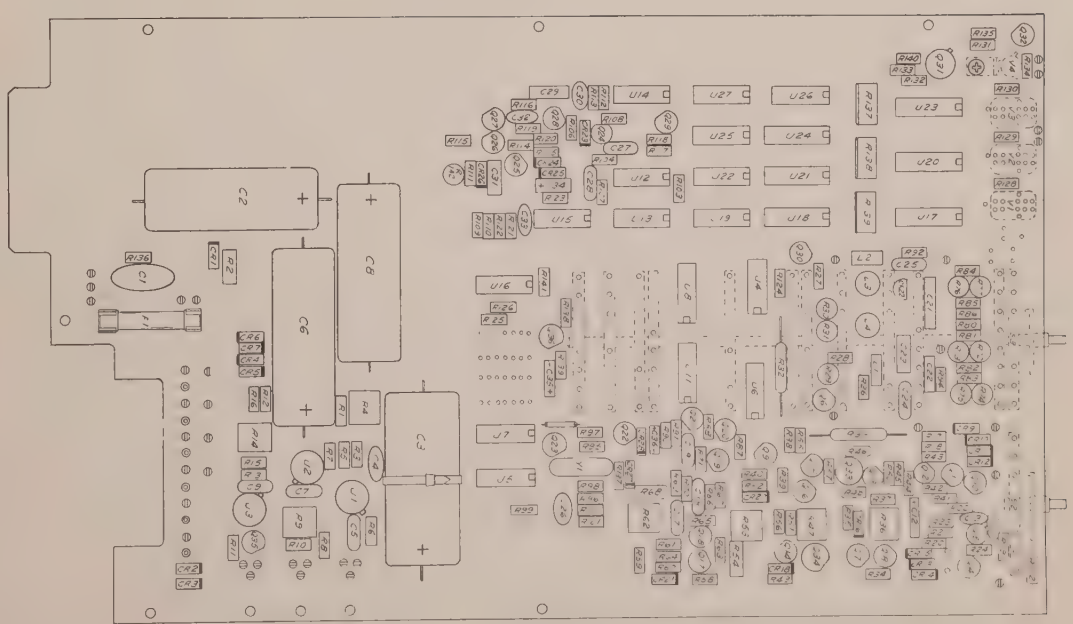
2) CAPACITOR VALUES IN µF.

3) ALL DIODES ARE IN4151.

L/C METER SCHEMATIC D33910C



L/C METER TEST ASSEMBLY D39399B



L/C METER P.C. ASSEMBLY D33913C

L/C METER P.C. ASSEMBLY PARTS LIST

REF.	DESCRIPTION	SD PART NO.
	L/C Meter P.C. Assembly	D33913C
	L/C Meter P.C. Schematic	D33910C
C1	Capacitor, .005 μF, 1k V	03289940
C2	Capacitor, 20 μF, 350 V, Elect	C1094
C3	Capacitor, 7100 μF, 10 V, Elect	C1188
C4	Capacitor, .001 μF, 1k V, Disc.	C0235
C5	Capacitor, 100 pF, 500 V, D.M.	C0536
C6	Capacitor, 500 μF, 30 V, Elect	C1134
C7	Capacitor, 470 pF, 300 V, D.M.	C0542
C8	Capacitor, 500 μF, 30 V, Elect	C1134
C9	Capacitor, 100 pF, 500 V, D.M.	C0536
C10	Capacitor, .01 μF, 100 V, Disc.	C0556
C11	Not Used	
C12	Capacitor, 1 μF, 35 V, Disc.	C0524
C13	Capacitor, .001 μF, 1k V, Disc.	C0235
C14	Not Used	
C15	Not Used	
C16	Not Used	
C17	Capacitor, 12 pF, 500 V, D.M.	C0637
C18	Capacitor, 27 pF, 500 V, D.M.	C0530
C19	Capacitor, 15 pF, 500 V, D.M.	C0528
C20	Not Used	
C21	Capacitor, .39 μF, 100 V, Met Mylar	C1237
C22	Capacitor, .039 μF, 100 V, Met Mylar	C1238
C23	Capacitor, .0039 μF, 200 V, Met Mylar	C1239
C24	Capacitor, 390 pF, 500 V	C0541
C25	Capacitor, 470 pF, 300 V, D.M.	C0542
C26	Capacitor, .01 μF, 100 V, Disc.	C0556
C27	Capacitor, 100 pF, 500 V, D.M.	C0536
C28	Capacitor, 560 pF, 300 V, D.M.	C1079
C29	Capacitor, 1 μF, Met Mylar	C0734
C30	Capacitor, .01 μF, 100 V, Disc.	C0556
C31	Capacitor, .033 μF, 100 V, Met Mylar	C0735
C23	Capacitor, .001 μF, 1k V, Disc.	C0235
C33	Capacitor, .001 μF, 1k V, Disc.	C0235
C34	Capacitor, 47 μF, 6 V, Tant	C1089
CR1	Diode, 1N4005	CR0284
CR2	Diode, 1N4005	CR0284
CR3	Diode, 1N4005	CR0284
CR4	Diode, 1N4005	CR0284
CR5	Diode, 1N4005	CR0284

L/C METER P.C. ASSEMBLY PARTS LIST (Cont'd)

REF.	DESCRIPTION	SD PART NO.
CR6	Diode, 1N4005	CR0284
CR7	Diode, 1N4005	CR0284
CR8	Not Used	
CR9	Diode, 19330	19330
CR10	Diode, 1N4151	CR0150
CR11	Diode, 1N4151	CR0150
CR12	Diode, 19330	19330
CR13	Diode, 1N4005	CR0284
CR14	Diode, 1N4005	CR0284
CR15	Diode, 1N751A	CR0095
CR16	Diode, 1N753A	CR0163
CR17	Not Used	
CR18	Diode, 1N4830	CR0361
CR19	Not Used	
CR20	Diode, 1N957B	CR0292
CR21	Diode, 1N751A	CR0095
CR22	Diode, MV2103	CR0353
CR23	Diode, 1N4151	CR0150
CR24	Diode, 1N4151	CR0150
CR25	Diode, 1N4151	CR0150
CR26	Diode, 1N4151	CR0150
CR27	Diode, 1N4151	CR0150
CR28	Diode, 1N4151	CR0150
F1	Fuse, 1 Amp, 3AG	F0005
L1	Inductor, 470 mH	L0019
L2	Inductor, 47 mH	L0074
L3	Inductor, 22-41 µH, Adjustable	L0170
L4	Inductor, 43-85 µH, Adjustable	L0171
Q1	Not Used	
Q2	Not Used	
Q3	Not Used	
Q4	Transistor, 2N3638	Q0181
Q5	Transistor, 40673	Q0297
Q6	Transistor, 2N3643	Q0179
Q7	Transistor, 2N3640	Q0178
Q8	Transistor, 2N3646	Q0218
Q9	Transistor, 2N3640	Q0178
Q10	Transistor, 2N3906	Q0248

L/C METER P.C. ASSEMBLY PARTS LIST (Cont'd)

REF.	DESCRIPTION	SD PART NO.
Q11	Transistor, 2N3904	Q0247
Q12	Transistor, 2N3646	Q0218
Q13	Transistor, 2N3646	Q0218
Q14	Transistor, 2N3646	Q0218
Q15	Transistor, 2N3646	Q0218
Q16	Transistor, 2N3646	Q0218
Q17	Transistor, 2N3640	Q0178
Q18	Transistor, 2N3646	Q0218
Q19	Transistor, 2N3646	Q0218
Q20	Transistor, 2N3640	Q0178
Q21	Transistor, 2N3646	Q0218
Q22	Transistor, 2N3646	Q0218
Q23	Transistor, 2N3646	Q0218
Q24	Transistor, 2N4871	Q0266
Q25	Transistor, 2N3646	Q0218
Q26	Transistor, 2N3646	Q0218
Q27	Transistor, 2N3646	Q0218
Q28	Transistor, 2N3646	Q0218
Q29	Transistor, 2N3646	Q0218
Q30	Transistor, 2N3646	Q0218
Q31	Transistor, 15840	15840
Q32	Transistor, 2N3646	Q0218
Q33	Transistor, 39934	39934
Q34	Transistor, 39934	39934
Q35	Transistor, 2N3646	Q0218
R1	Resistor, 5.6k, 1/4 W, 5%	R0821
R2	Resistor, 270k, 1/2 W, 5%	R0147
R3	Resistor, 680 Ω, 1/4 W, 5%	R1234
R4	Resistor, 360° T, 500 Ω, Potentiometer	R2617
R5	Resistor, 2.7k, 1/4 W, 5%	R0937
R6	Resistor, 680 Ω, 1/4 W, 5%	R1234
R7	Resistor, 1.8k, 1/4 W, 5%	R0959
R8	Resistor, 2k, 1/4 W, 5%	R0734
R9	Resistor, 1, 360° T, Potentiometer	R2629
R10	Resistor, 3k, 1/4 W, 5%	R0711
R11	Resistor, 2k, 1/4 W, 5%	R0734
R12	Resistor, 3.9k, 1/4 W, 5%	R0939
R13	Resistor, 3.01k, 1/4 W, 1%	R2338
R14	Resistor, 350 R, 500 Ω, Potentiometer	R2617
R15	Resistor, 3.01k, 1/4 W, 1%	R2338

L/C METER P.C. ASSEMBLY PARTS LIST (Cont'd)

REF.	DESCRIPTION	SD PART NO.
R16	Resistor, 1.2k, 1/4 W, 5%	R0809
R17	Resistor, 15k, 1/4 W, 5%	R0728
R18	Resistor, 15k, 1/4 W, 5%	R0728
R19	Resistor, 100 Ω, 1/4 W, 5%	R0966
R20	Resistor, 4.7k, 1/4 W, 5%	R0892
R21	Resistor, 1.5k, 1/4 W, 5%	R0783
R22	Resistor, 2.7k, 1/4 W, 5%	R0937
R23	Resistor, 5.1 M, 1/4 W, 5%	02355500
R24	Resistor, 1 M, 1/4 W, 5%	R0962
R25	Not Used	
R26	Resistor, MF 649 Ω, RN55F, 1/10 W, 1%	R2618
R27	Resistor, MF 221 Ω, RN55F, 1/10 W, 1%	R2622
R28	Resistor, MF 221 Ω, RN55F, 1/10 W, 1%	R2622
R29	Resistor, 100 Ω, Potentiometer 340 Equiv.	R2374
R30	Resistor, 50 Ω, Potentiometer 340 Equiv.	R2369
R31	Resistor, 50 Ω, Potentiometer 340 Equiv.	R2369
R32	Resistor, 100 Ω, RN65D, 1/4 W, 1%	R2620
R33	Resistor, 150 Ω, RN65D, 1/4 W, 1%	R2619
R34	Resistor, 5.6k, 1/4 W, 5%	R0821
R35	Resistor, 1.2k, 1/4 W, 5%	R0809
R36	Resistor, 1k, Potentiometer 360 T	R2629
R37	Resistor, 2.2k, 1/4 W, 5%	R0749
R38	Resistor, 15k, 1/4 W, 5%	R0728
R39	Resistor, 4.7k, 1/4 W, 5%	R0892
R40	Resistor, 3.3k, 1/4 W, 5%	R0742
R41	Resistor, 120k, 1/4 W, 5%	R0807
R42	Resistor, 10k, 1/4 W, 5%	R0766
R43	Resistor, 1.2k, 1/4 W, 5%	R0809
R44	Resistor, 3.9k, 1/4 W, 5%	R0939
R45	Resistor, 470 Ω, 1/4 W, 5%	R1044
R46	Resistor, 1k, 1/4 W, 5%	R0765
R47	Resistor, 500 Ω, Potentiometer 360 T	R2617
R48	Resistor, 1k, 1/4 W, 5%	R0765
R49	Resistor, 1.8k, 1/4 W, 5%	R0959
R50	Resistor, 1k, 1/4 W, 5%	R0765
R51	Resistor, 2.2k, 1/4 W, 5%	R0749
R52	Resistor, 1/5k, 1/4 W, 5%	R0783
R53	Resistor, 500 Ω, Potentiometer 360 T	R2617
R54	Resistor, 1k, Potentiometer 66 P	R2630
R55	Resistor, 1k, 1/4 W, 5%	R0765

L/C METER P.C. ASSEMBLY PARTS LIST (Cont'd)

REF.	DESCRIPTION	SD PART NO.
R56	Resistor, 2.2k, 1/4 W, 5%	R0749
R57	Resistor, 1k, 1/4 W, 5%	R0765
R58	Resistor, 1k, 1/4 W, 5%	R0765
R59	Resistor, 3.9k, 1/4 W, 5%	R0939
R60	Resistor, 7.5k, 1/4 W, 5%	R0884
R61	Resistor, 220k, 1/4 W, 5%	R0967
R62	Resistor, 500k, Potentiometer 360 T	R2628
R63	Resistor, 15k, 1/4 W, 5%	R0728
R64	Resistor, 5.6k, 1/4 W, 5%	R0821
R65	Resistor, 4.7k, 1/4 W, 5%	R0892
R66	Resistor, 2k, 1/4 W, 5%	R0734
R67	Resistor, 15k, 1/4 W, 5%	R0728
R68	Resistor, 1k, Potentiometer 66 P	R2630
R69	Resistor, 5.6k, 1/4 W, 5%	R0821
R70	Resistor, 470 Ω, 1/4 W, 5%	R1044
R71	Resistor, 1k, 1/4 W, 5%	R0765
R72	Resistor, 50 Ω, Potentiometer 340 Equiv.	R2369
R73	Resistor, 50 Ω, Potentiometer 340 Equiv.	R2369
R74	Resistor, 100 Ω, Potentiometer 340 Equiv.	R2374
R75	Resistor, 100 Ω, Potentiometer 340 Equiv.	R2374
R76	Resistor, 500 Ω, Potentiometer 340 Equiv.	R2375
R77	Resistor, 500 Ω, Potentiometer 340 Equiv.	R2375
R78	Not Used	
R79	Not Used	
R80	Resistor, MF 196 Ω, RN55D, 1/10 W, 1%	R2623
R81	Resistor, MF 511 Ω, RN55D, 1/10 W, 1%	R2621
R82	Resistor, MF 1.02k, RN55D, 1/10 W, 1%	R2625
R83	Resistor, MF 2.05k, RN55D, 1/10 W, 1%	R2624
R84	Resistor, MF 4.87k, RN55D, 1/10 W, 1%	R2626
R85	Resistor, MF 4.87k, RN55D, 1/10 W, 1%	R2626
R86	Resistor, MF 25.5K, RN55D, 1/10 W, 1%	R2627
R87	Resistor, 1k, 1/4 W, 5%	R0765
R88	Resistor, 10k, 1/4 W, 5%	R0766
R89	Not Used	
R90	Resistor, 8.2k, 1/4 W, 5%	R0883
R91	Resistor, 470 Ω, 1/4 W, 5%	R1044
R92	Resistor, 1 M, 1/4 W, 5%	R0962
R93	Not Used	
R94	Resistor, 200 Ω, 1/4 W, 5%	R0736
R95	Resistor, 1k, 1/4 W, 5%	R0765

L/C METER PLC. ASSEMBLY PARTS LIST (Cont'd)

REF.	DESCRIPTION	SD PART NO.
R96	Resistor, 3.9k, 1/4 W, 5%	R0939
R97	Resistor, 3k, 1/4 W, 5%	R0711
R98	Resistor, 18k, 1/4 W, 5%	R0785
R99	Resistor, 1.2k, 1/4 W, 5%	R0809
R100	Resistor, 3.9k, 1/4 W, 5%	R0939
R101	Resistor, 150 Ω, 1/4 W, 5%	R0983
R102	Resistor, 58 Ω, 1/4 W, 5%	R1426
R103	Resistor, 1k, 1/4 W, 5%	R0765
R104	Resistor, 5.8 M, 1/4 W, 5%	R2306
R105	Resistor, 39k, 1/4 W, 5%	R0765
R106	Resistor, 33 M, 1/4 W, 5%	R0552
R107	Resistor, 5.6k, 1/4 W, 5%	R0821
R108	Resistor, 150 Ω, 1/4 W, 5%	R0983
R109	Resistor, 1.2k, 1/4 W, 5%	R0809
R110	Resistor, 1k, 1/4 W, 5%	R0765
R111	Resistor, 47k, 1/4 W, 5%	R0777
R112	Resistor, 5.6k, 1/4 W, 5%	R0821
R113	Resistor, 6.8k, 1/4 W, 5%	R0696
R114	Resistor, 15k, 1/4 W, 5%	R0728
R115	Resistor, 2.7k, 1/4 W, 5%	R0937
R116	Resistor, 12k, 1/4 W, 5%	R0759
R117	Resistor, 1k, 1/4 W, 5%	R0765
R118	Resistor, 470 Ω, 1/4 W, 5%	R1044
R119	Resistor, 5.6k, 1/4 W, 5%	R0821
R120	Resistor, 470 Ω, 1/4 W, 5%	R0821
R121	Resistor, 4.7k, 1/4 W, 5%	R0892
R122	Resistor, 3.9k, 1/4 W, 5%	R0939
R123	Resistor, 470 Ω, 1/4 W, 5%	R1044
R124	Resistor, 1k, 1/4 W, 5%	R0765
R125	Resistor, 5.6k, 1/4 W, 5%	R0821
R126	Resistor, 5.6k, 1/4 W, 5%	R0821
R127	Resistor, 5.6k, 1/4 W, 5%	R0821
R128	Resistor, 15k, 1/4 W, 5%	R0728
R129	Resistor, 15k, 1/4 W, 5%	R0728
R130	Resistor, 15k, 1/4 W, 5%	R0728
R131	Resistor, 47k, 1/4 W, 5%	R0777
R132	Resistor, 1k, 1/4 W, 5%	R0765
R133	Resistor, 5.6k, 1/4 W, 5%	R0821
R134	Resistor, 100 Ω, 1/4 W, 5%	R0966
R135	Resistor, 1k, 1/4 W, 5%	R0765
R136	Resistor, 1k, 1/4 W, 5%	R0765

L/C METER P.C. ASSEMBLY PARTS LIST (Cont'd)

REF.	DESCRIPTION	SD PART NO.
R137	Resistor, 6.8k, 1/4 W, 5%	R0696
R138	Resistor, 1k, 1/4 W, 5%	R0765
R139	Resistor, 18k, 1/4 W, 5%	R0785
R140	Resistor, 1k, 1/4 W, 5%	R0765
R141	Resistor, 2.2k, 1/4 W, 5%	R0749
R142	Resistor, 10k, Potentiometer 340 Equiv.	R2383
U1	Integrated Circuit, μA723C	25756
U2	Integrated Circuit, μA723C	25756
U3	Integrated Circuit, μA723C	25756
U4	Integrated Circuit, SN7490N	25732
U5	Integrated Circuit, SN7490N	25732
U6	Integrated Circuit, SN7490N	25732
U7	Integrated Circuit, SN7490N	25732
U8	Integrated Circuit, SN7490N	25732
U9	Option	
U10	Option	
U11	Integrated Circuit, SN7473N	19709
U12	Integrated Circuit, SN15846N	19716
U13	Integrated Circuit, SN15846N	19716
U14	Integrated Circuit, SN15846N	19716
U15	Integrated Circuit, SN7400N	19705
U16	Integrated Circuit, SN15846N	19716
U17	Integrated Circuit, SN7441N	19707
U18	Integrated Circuit, SN7475N	25731
U19	Integrated Circuit, SN7490N	25732
U20	Integrated Circuit, SN7441N	19707
U21	Integrated Circuit, SN7475N	25731
U22	Integrated Circuit, SN7490N	25732
U23	Integrated Circuit, SN7441N	19707
U24	Integrated Circuit, SN7475N	25731
U25	Integrated Circuit, SN7490N	25732
U26	Integrated Circuit, SN7473N	19709
U27	Integrated Circuit, SN7473N	19709
U28	Resistor Network, 4x5 k, 1/10 W, 20%	A27867
U29	Resistor Network, 4x5 k, 1/10 W, 20%	A27867
U30	Resistor Network, 4x5 k, 1/10 W, 20%	A27867
V1	Readout Tube, NL58595	V0131
V2	Readout Tube, NL58595	V0131
V3	Readout Tube, NL58595	V0131
V4	Lamp Neon, A-Z61	I0082

L/C METER P.C. ASSEMBLY PARTS LIST (Cont'd)

REF.	DESCRIPTION	SD PART NO.
Y1	Crystal, 1 MHz	Y0019
S1	Not Used	
S2	Rotary Switch, PC Mount (Functions)	B33906
S3	Rotary Switch, PC Mount (Range)	B33905

L/C METER FINAL ASSEMBLY PARTS LIST

REF.	DESCRIPTION	SD PART NO.
DS1	Diode, Light Emitting	CR0367
DS2	Diode, Light Emitting	CR0367
L5	Bead, Ferrite	H0654
L6	Bead, Ferrite	H0654
L7	Bead, Ferrite	H0654
L8	Bead, Ferrite	H0654
L9	Bead, Ferrite	H0654
L10	Bead, Ferrite	H0654
P1	Cord, Line	W0088
Q1	Transistor, 2N4921	Q0267
Q2	Transistor, 2N4921	Q0267
R25	Resistor, 500 Ω, Pot	R2616
R93	Resistor, 10 k, Pot	R2615
S1	Switch, Slide (Power)	05034990
T1	Transformer, Power	C39032